THURSDAY, MARCH 9, 1916.

HISTORY OF CHEMISTRY.

Historical Introduction to Chemistry. By Prof. T. M. Lowry. Pp. xv+581. (London: Macmillan and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.

THE history of a physical science like chemistry differs fundamentally from general history inasmuch as in the former, speaking broadly, men create the epochs, whereas in the latter epochs make the men. When we take a retrospective view of the progress of chemistry we see that its development is, in the main, irregular and spasmodic. Although there are no periods of actual retrogression, except possibly the one that followed the burning of the Alexandrine libraries, there are periods of comparative stagnation interrupted by sudden breaks, so to say, in the curve of its continuity. These breaks mark epochs of new departure, arising from discoveries, frequently wholly unexpected and often revolutionary in character, and nearly always due to individuals working independently of their fellows, and not consciously influenced by any *Zeitgeist*.

On the other hand, in political, economic, or sociological history, we are usually able to trace a general movement in communities, or of powerful groups of society, or of definite interests, and the more or less gradual and progressive working of a popular sentiment which is ultimately given practical effect to by the leader or statesman of sufficient perspicacity to read aright the signs of the times.

Hence, on account of this essential difference, the history of chemistry is necessarily to a large extent the history of its leading men—that is, of the pioneers whose work constitutes those new departures which make up the successive epochs in its progress.

This difference between the leaders in science and in politics, it may be noted in passing, is not sufficiently recognised by the community. The successful political leader in these democratic days in reality seldom leads: he follows, and is directed by the popular will; and his success as a practical politician depends upon his astuteness in divining the psychological moment in which to give effect to that will. The leaders in science—the Boyles, Newtons, Davys, Faradays, Daltons—are in no wise controlled or influenced by any analogous movement on the part of a community. They pursue their investigations and make their discoveries independently of any prescribed demand. In this sense they are real leaders, and by their own independent action impose such natural laws as they may be able to promulgate.

It is, of course, possible to teach the historical development of chemistry impersonally, and doubtless this is the more rational method. But it offers far more difficulties than the other, and from the point of view of the ordinary student is probably less instructive, as it is certainly far less interesting. In the book before us something in the nature of a compromise has been attempted between the impersonal and the purely biographical methods, but, as frequently happens in compromises, the result is not wholly successful. The author states that he has made no attempt to write a formal history of chemistry either of its various periods, or of the biographical stories of its pioneers. His method is to take certain substances, or groups of substances, such as the Acids; Chalk, Lime, and the Alkalis; Muriatic Acid and Chlorine; Inflammable Gases, etc., distributed over about a dozen chapters, and in the remaining eight chapters of the twenty chapters constituting the book to deal with certain theoretical conceptions of the science, *e.g.* the Atomic and Molecular Theories; Molecular Architecture; Classification; Balanced Actions, etc. As regards the first section it is not obvious why the particular selection or its particular sequence was adopted. It may be that the merit of any particular selection is largely a matter of opinion; or possibly the author may think that selection is the best which in his judgment enables him to group the largest number of historical facts in something approaching to chronological order.

Each chapter is split up into sections, designated as A, B, C, D, etc., with corresponding sub-headings, and it concludes with a summary and supplement. The object of the supplement, apparently, is to deal with statements that had been omitted from the main body of the chapter, or which for some reason or other could not be conveniently treated in their proper place. In many cases the supplements consist almost wholly of elementary chemical equations in explanation of chemical changes referred to in the text. As these are expressed by up-to-date conventions it may have occurred to the author that their very modernity would be as incongruous as the absurd anachronisms which he rightly condemns, such as the substitution of the bunsen burner for the big spirit lamp in illustrations of Dumas's apparatus for determining the gravimetric composition of water; or in the picture of Lavoisier's red-hot gun-barrel, in which rubber corks take the place of clay-joints.

But whatever may be the reasons which in-

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duced the author to adopt his particular treatment, the effect is to give his work a somewhat disjointed structure. The treatment is slight and "sketchy," and at times inadequate. It is irrational, for example, to dismiss the work of twenty centuries in about as many lines, but this is practically all the space that is given to ancient and alchemistic chemistry. To say that the study of chemistry begins with the work of Boyle is on a par with Wurtz's famous statement that it owes its origin to Lavoisier, and is equally untrue.

Dr. Lowry's book, in spite of occasional slipshod writing, is interesting reading, and the student, if already furnished with a little chemical knowledge, will pick up much information concerning certain broad features in the development of the science since the middle of the eighteenth century. The illustrations of classical apparatus are a valuable feature, although we are unable to see the relevancy of the pictures of crystallised minerals and salts taken from the national collections in the British Museum. They are like the tropes and metaphors which King James deprecated in the sermon—"brilliant wild flowers in the field of corn, very pretty, but of no particular advantage to the corn."

RELATIVITY AND ELECTRONS.

Relativity and the Electron Theory. By E. Cunningham. Pp. vii+96. (London: Longmans, Green and Co., 1915.) Price 4*s.* net.

THE principle of relativity has gradually acquired a fundamental position in theoretical physics, and the appearance of an introductory monograph on the subject will be welcomed by all who wish to have a knowledge of its essentials. The present work, as stated in the preface, is written with the purpose of setting out as clearly as possible the relation of the principle to the generally accepted electron theory. Only quite elementary mathematical analysis is employed throughout the book; those who wish to penetrate more deeply in the subject being referred to the author's larger work on "The Principle of Relativity."

In the latter part of the book the principle of relativity is presented from Minkowski's point of view. The four-dimensional form of relativity is of very great importance, partly on account of its elegance and simplicity, but also because of its suggestiveness in the present transition stage of dynamics. Unfortunately, only a short outline of the four-dimensional vector analysis of Minkowski and his disciples is given. On p. 72 examples of 4-vectors are given in a form which is open to criticism. The point-instant (x, y, z, t) is called a 4-vector. It would be more satisfactory to denote the 4-vector by (x, y, z, ict), since ict and not t is actually the fourth component of the vector in question. A similar remark applies to $\kappa(u_x, u_y, u_z, 1)$ (on the same page), which should be written $\kappa(u_x, u_y, u_z, ic)$, in which form it would be consistent with the equation at the foot of p. 75, viz.:

$$(\mathrm{S}_x, \mathrm{S}_y, \mathrm{S}_z, \mathrm{S}_u) = \rho(\mathrm{U}_x, \mathrm{U}_y, \mathrm{U}_z, ic)/c.$$

The quantity denoted by "κ" is, in consequence of a printer's omission, imperfectly defined. The author introduces four-dimensional vectors in the "New Mechanics" in an excellent way by showing how they serve to unify the two aspects of "force" as the "time rate of change of momentum" (Galileo) and "space rate of change of energy" (Huygens). One of the characteristic features of Minkowski's presentation of the principle of relativity is its capacity for unifying or reconciling different and, in some cases, apparently contradictory aspects of phenomena.

In the final chapter the author outlines the way in which the "objections of those who demand a *real* æther to carry *real* effects" can be met.

The work is one of considerable merit, and provides a really good and sound introduction to the subject with which it deals. W. W.

THE HANDWORKING OF IRON AND STEEL.

Forging of Iron and Steel. By W. A. Richards. Pp. viii+219. (London: Constable and Co., Ltd., 1915.) Price 6*s.* 6*d.* net.

THE title of the above work is somewhat misleading, in that its scope is much narrower than is suggested by the title. Apart from a short chapter at the end on steam and power hammers, it deals only with hand-forging in its various aspects. The book, which is stated to be intended both for the "high-school boy" and the "veteran smith"—it is written by an American—opens with a chapter on the historic use of iron and steel from early periods. It then deals in brief review with the smelting of iron ores and the production of cast irons, wrought irons, and steels, the author stating that it is unnecessary to go deeply into the subject of metallurgy or to introduce metallurgical theory. We are told (on page 20) that the air pressure in the blast furnace is from 15 to 25 lb. per square inch. No doubt in the hard-driven American furnaces, where

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